



Strength Exercise In Weight Loss, Wellness, And Chronic Disease Prevention

U. S. Navy Fitness

***Wayne L. Westcott, Ph.D.,
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Consideration #1



- **Approximately 75% of all Americans do too little physical activity to attain any fitness/health benefits.**

Report of the Surgeon General

USDHHS - 1996

Consideration #2



Photo courtesy of www.obesityinamerica.org

- **Approximately 75% of all Americans are overweight/overfat.**

Ohio University

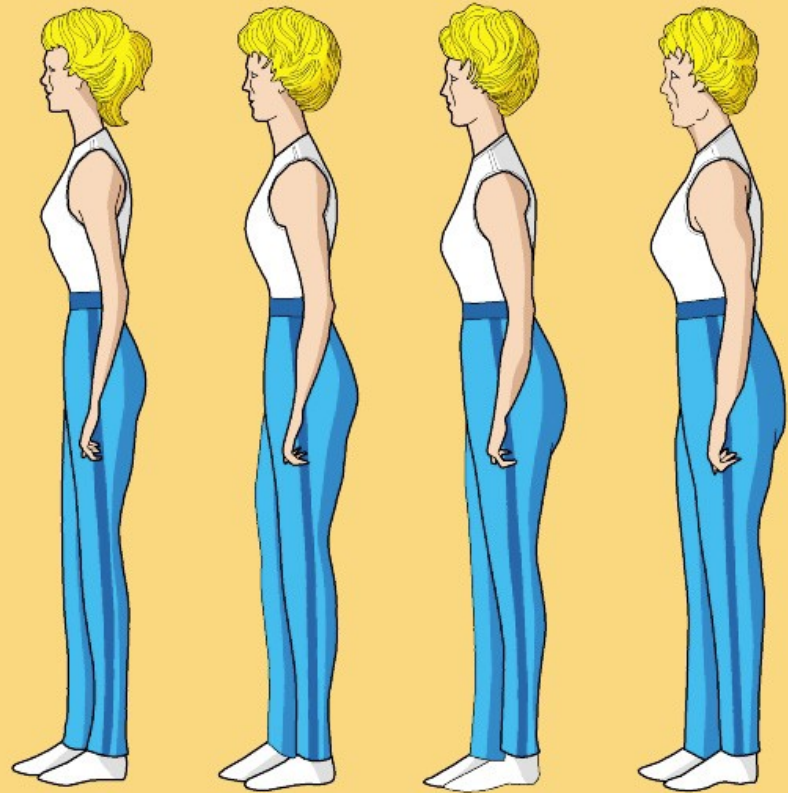
Scripps Howard News Service -1996

Consideration #3

- **Weight gain underestimates fat gain by up to 50% due to unrecognized muscle loss.**



Body weight and body composition changes during adult life.



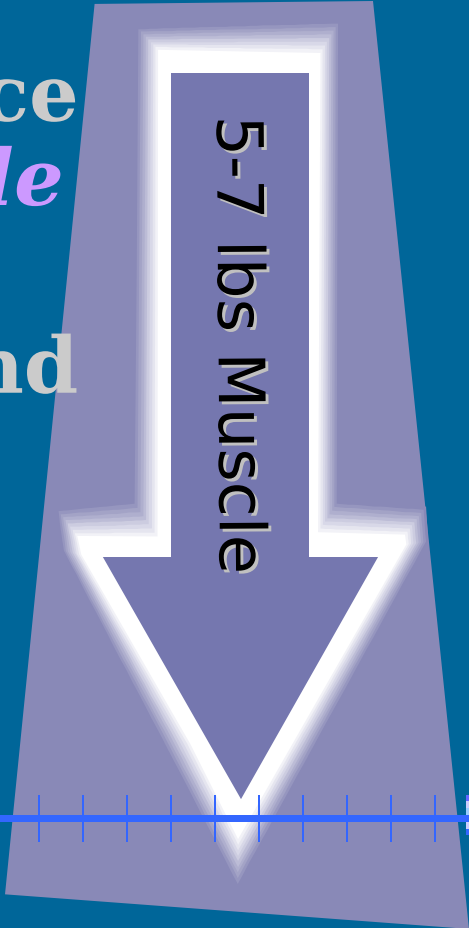
Age:	20	30	40	50
Body weight (lbs.)	126	136	146	156
Muscle (lbs.)	45	40	35	30
Fat (lbs.)	29	44	59	74
Percent Fat (%)	23	32	40	47

Consideration #4

- American adults experience gradual decrease in *muscle tissue*.
- Approximately 5 to 7-pound muscle loss per decade.

Forbes 1976

Evans & Rosenberg 1992



5-7 lbs Muscle

Consideration #5

- American adults experience gradual decline in *resting metabolism*.
- Approximately 3-5% percent metabolic reduction per decade.



3-5% RMR

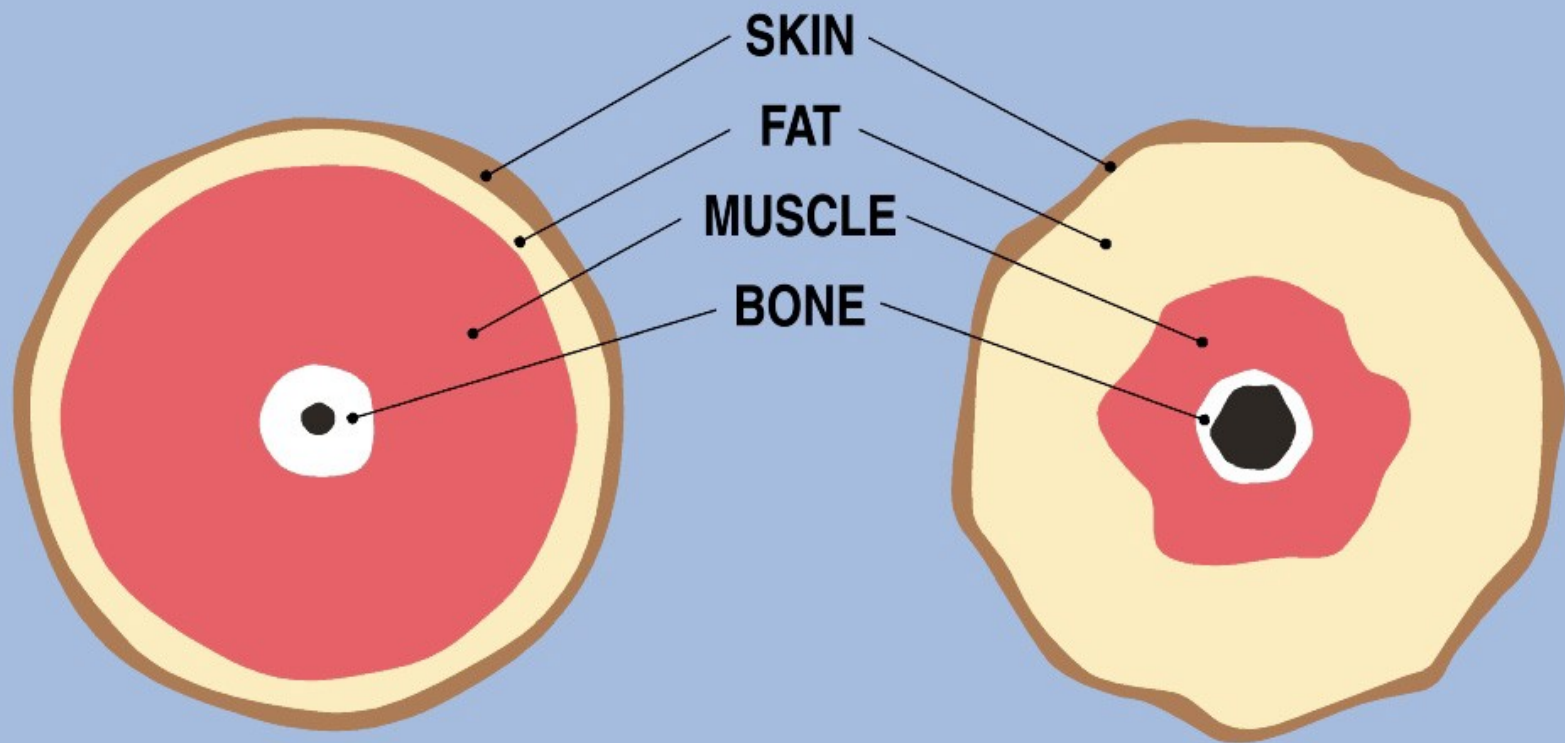
Keyes et al. 1973
Evans & Rosenberg 1992

Consideration #6

Steps To Fat Gain

1. Less muscle tissue
2. Lower resting metabolism
3. Fewer calories used
4. More calories stored in fat cells

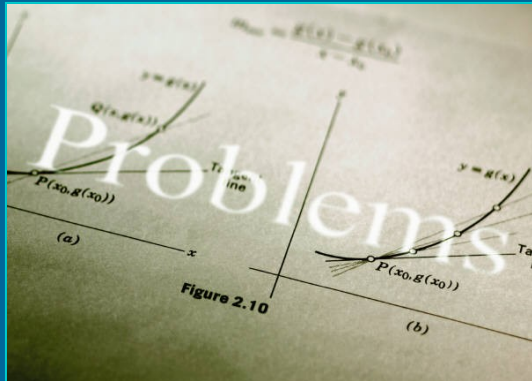




Cross-section of the four major components in the thigh of a well-conditioned young woman.

Cross-section of the four major components in the thigh of an unfit middle-aged woman.

Consideration #7



1. Too little muscle
2. Too low metabolic rate
3. Too much fat

Consideration #8

Dieting Alone - Limited Results

1. Reduces muscle
 2. Reduces metabolism
 3. Reduces fat
- 25% of weight loss is muscle *Ballor & Poehl*
 - 95% of dieters regain weight *Brehm & Kelle*

(undesirable)

(undesirable)



Weight Loss and the Effect on RMR

RMR can change significantly during a weight management program and there are no individual characteristics to predict when and how much RMR will change. The standard deviation in each reference point is ± 300 Kcals.

250 Subjects, University of Colorado

RMR reduction is due to:

- Decreased Body Weight
- Decreased Muscle Mass
- Reduced Calorie Intake



Alexander, H.A. et al. (2002) Efficacy of a Resting Metabolic Rate Based Energy Balance Prescription in a Weight Management Program *Obesity Research, Presented at Nutrition Week Conference*

Consideration #9

Endurance Exercise Alone - Limited Results

1. Does not replace muscle (undesirable)
2. Does not increase resting metabolism (undesirable)
3. Reduces fat (desirable)
4. Improves cardiovascular fitness (desirable)



Consideration #10

Strength Exercise Alone - Good Results



Muscle

(desirable)

Metabolism

(desirable)

(desirable)

4. Improves musculoskeletal fitness

(desirable)

Consideration #11

Strength training effects on body composition are relative to entry level percent body fat.

South Shore YMCA Study #1

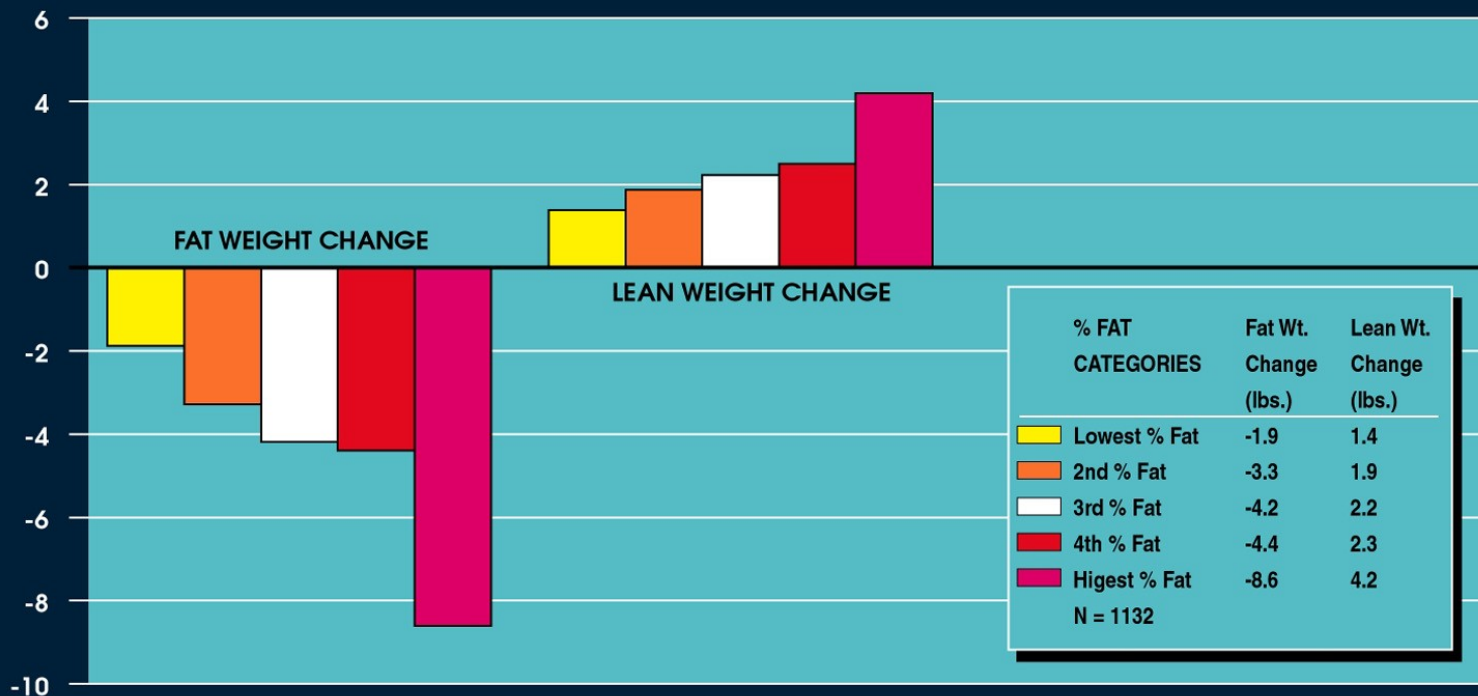
Westcott and Guy 1996

1132 Men and Women (21-80 years) Body composition changes based on entry level percent body fat quintiles.



Keeping Fit Program

Body Composition Changes Based on Entry Percent Fat



FAT WEIGHT CHANGE VS. LEAN WEIGHT CHANGE

Consideration #12

Primary health/fitness benefit of strength training:

Concurrent increase in muscle mass and decrease in fat mass, thereby reversing these effects of sedentary aging.



South Shore YMCA

Study #2

Westcott 2003

- 95 Women (x age = 45 years)
- All performed 20 minutes strength training (10 Nautilus machines)
- All performed 20 minutes endurance exercise (walking & cycling)
- All trained 3 days (MWF) for 8 weeks
- Ultrasound measurements at midpoint of anterior thigh:
 - Muscle layer: +1.8 mm
 - Fat layer: -1.9 mm

Muscles analogous to an automobile...



-Engine- -Chassis-
-Springs/Shocks -Wheels/Tires-

Tufts University Study

Campbell et al. 1994

American Journal of Clinical Nutrition (60:167-179)

- **12 Men and Women (56-80 years)**
- **12 Weeks of basic strength (4 exer. x 3 sets)**
- **Added 3 pounds of lean (muscle) weight**
- **Lost 4 pounds of fat weight**
- **Increased resting metabolism 7 percent**
- **Increased daily energy expenditure 15 percent**

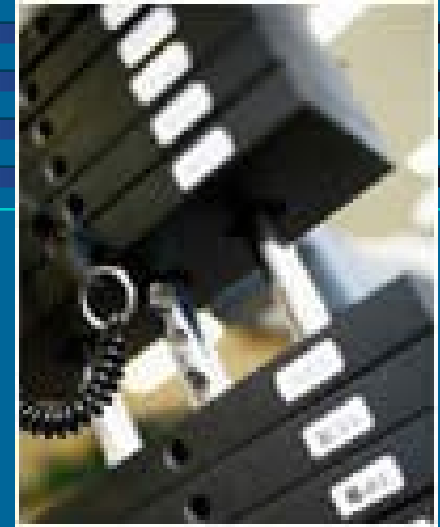
University of Maryland Study

Pratley et al. 1994

Journal of Applied Physiology (76:133-137)

- **13 Men (50-65 years)**
- **16 Weeks of basic strength (14 exer. x 1 set)**
- **Added 3.5 pounds of lean (muscle) weight**
- **Lost 4 pounds of fat weight**
- **Increased resting metabolism 8 percent**

Consideration #13



Strength training associated with:

- 1. Consistent increases in lean weight**
- 2. Inconsistent decreases in fat weight**



South Shore YMCA

Study #1

Westcott and Guy 1996

- 263 Men and women (21-80 years)
- 4 Groups asked to follow same nutrition plan (1700-1400 cal)
- All performed 20 minutes strength training (10 Nautilus machines)
- All performed 20 minutes endurance exercise (walking & cycling)
- All trained 2 or 3 days a week for 8 weeks (T/Th or MWF)



South Shore YMCA

Study #1

Westcott and Guy 1996

Results

	Group 1 (n=90)	Group 2 (n=81)	Group 3 (n=61)	Group 4 (n=31)
Weight Change	-7 lbs	-5 lbs	-3 lbs	-2 lbs
Lean Wt Change	+3 lbs	+3 lbs	+3 lbs	+3 lbs
Fat Wt Change	-10 lbs	-8 lbs	-6 lbs	-5 lbs
Body Comp Change	13 lbs	11 lbs	9 lbs	8 lbs



Consideration #14

**Dietary compliance is
notedly the most
important factor in fat loss.**

**Unfortunately, we have
experienced consistently
inconsistent results in the
nutrition area and have decided to
leave dietary intervention to
qualified professionals
(Registered Dieticians).**

Consideration #15

Secondary health/fitness benefit of strength training:

- Reduced risk of **type 2 diabetes** due to improved glucose uptake.
- 23% increase after 4 months strength training.

Hurley 1994

Consideration #16

Secondary health/fitness benefit of strength training:

- Reduced risk of **colon cancer** due to improved gastrointestinal transit speed.
- 56% increase after 3 months strength training.

Koffler 1992

Consideration #17

Secondary health/fitness benefit of strength training:

- Reduced risk of **heart attack** and **stroke** due to reduced resting blood pressure.
- -4 mmHg systolic and -2 mmHg diastolic after 10 weeks strength training.

Harris and Holly 1987

Westcott and Winett 2006

Consideration #18

Secondary health/fitness benefit of strength training:

- Reduced risk of **low back pain** due to strong erector spinae muscles.
- 80% low back patients significantly less pain after 10 weeks strength training.

Risch 1993

Consideration #19

Secondary health/fitness benefit of strength training:

- Reduced risk of **arthritic pain** due to stronger musculoskeletal system.
- Strength training eased pain of patients with osteoarthritis and rheumatoid arthritis.

Tufts 1994

Consideration #20

Secondary health/fitness benefit of strength training:

- Reduced risk of **depression** due to stronger musculoskeletal system and increased functional capacity.
- 87% senior subjects no longer clinically depressed after 10 weeks strength training.

Singh and Fiatarone 1997

Consideration #21

Secondary health/fitness benefit of strength training:

- Reduced risk of **osteoporosis** due to stronger musculoskeletal system.
- Higher rate of BMD increase during developmental years.

Effects of Strength Exercise on Female BMD

Girls (9-10 yrs.):	+6.2% BMD	Morris et al. 1997
Young Women (20-25 yrs.):	+1.3% BMD	Friedlander et al. 1995
Premenopausal Women:	+0.8% BMD	Gleeson et al. 1990
Postmenopausal Women:	+1.0% BMD	Nelson et al. 1994



Strength Training Recommendations and Results

- **American College of Sports
Medicine Guidelines**
- **South Shore YMCA Keeping Fit
Program**

Simple
****Sensible**Practical**Effective**

1995 ACSM Exercise Guidelines

Cardiovascular Endurance



- **20-60 Minutes Aerobic Activity**
- **60-90 Percent of Max Heart Rate**
- **Minimum 3 Days/Week**

1995 ACSM Exercise Guidelines

Muscular Strength

- 1 Set/Exercise
- 8-12 Reps/Set
- 8-10 Exercises for

Major Muscles

- Minimum 2 Days/Week





South Shore YMCA

Fitness Program

Protocol

- 10 Weeks
- 2-3 Days/Week - *T-Th or MWF*
- 20 Minutes Endurance -*Treadmill or Cycle*
- 20 Minutes Strength -*10 Nautilus Machines*
- Small Classes - *2 Instructors & 6 Participants*



South Shore YMCA

Fitness Program

Endurance Exercise Specifics

- **3 Minutes Warmup**
- **3 Minutes Cool-Down**
- **15 Minutes Steady State**
 - *70-80 Percent Max Heart Rate*
 - *13-15 RPE on Borg Effort-Scale*



South Shore YMCA

Fitness Program

Strength Training Specifics

- Leg Extension
- Leg Curl
- Double Chest
- Pullover
- Lateral Raise
- Biceps Curl
- Triceps Extension
- Abdominal Curl
- Low Back Extension
- Neck Flex/Ext
- **1 Set/Exercise*
- **8-12 Reps/Set*
- **6 Seconds/Rep (2 Secs Positive, 4 Secs Negative)*



South Shore YMCA

Fitness Program

Participants

- **1644 Men and Women (*21- 80 Years*)**
- **892 Trained 2 x Week (*Mean Age - 56*)**
- **752 Trained 3 x Week (*Mean Age - 51*)**



South Shore YMCA

Fitness Program

Results

- **8 Years (1996-2004)**
- **92 Percent Completion Rate (*All Subjects*)**
- **83 Percent Attendance Rate (2 x Week)**
- **80 Percent Attendance Rate (3 x Week)**
- **95 Percent Satisfaction Rate (*All Subjects*)**



South Shore YMCA

Fitness Program

Results By Frequency

	2 x Wk	3 x Wk	All
Body Weight (lb.)	-0.1	-1.3	-0.6
Percent Weight (%)	-1.9*	-2.2*	-2.0*
Fat Weight (lb.)	-3.2*	-4.4*	-3.7*
Lean Weight (lb.)	+3.1*	+3.1*	+3.1*
Systolic BP (mmHg)	-3.1*	-4.6*	-3.8*
Diastolic BP	-1.4*	-2.2*	-1.8*



South Shore YMCA

Fitness Program

Results By Gender

	Females	Males
Percent Fat (%.)	-1.8*	-2.8*
Fat Weight (lb.)	-3.0*	-5.9*
Lean Weight (lb.)	+2.6*	+4.6*
*sig (P<.05)		



South Shore YMCA

Fitness Program

Results By Age

	Lean Weight
21-44 Years	+2.5 lbs
45-54 Years	+3.1 lbs.
55-64 Years	+2.9 lbs.
65-80 Years	+3.2 lbs.
<i>(No significant difference by age)</i>	



South Shore YMCA

Fitness Program

Summary

10 Weeks Training (1644 *Subjects*)

- **2.0% Reduction in Percent Fat**
- **3.7 lb. Fat Loss**
- **3.1 lb. Lean (Muscle) Gain**
- **3.8 mmHg Systolic BP Decrease**
- **1.8 mmHg Diastolic BP Decrease**
- **Over 90% Completion Rate**
- **Over 80% Attendance Rate**
- **Over 95% Satisfaction Rate**



South Shore YMCA

Fitness Program

Recommendation

1995 ACSM Exercise Guidelines
are appropriate for
beginners

- Simple
- Sensible
- Practical
- Effective



Strength & Endurance Study

6-Month w/wo Protein Supplement

Subjects: 46 men & women (mean age = 59 years)

Exercise: 11 weightstack machines
20 minutes walking or cycling
ACSM training guidelines

Treatment: 24 subjects post-exercise
protein shake

(25 grams protein; 250 calories)

Strength & Endurance Study

6-Month w/wo Protein Supplement

Overall Results	1st 3 Months	2nd 3 Months	6 Months
Percent Fat (%)	-1.6*	-1.8*	-3.4*
Lean Weight (lbs)	+2.2*	+2.5*	+4.7*
Fat Weight (lbs)	-3.3*	-3.7*	-7.0*

*** Significant improvement ($p < 0.05$)**

Strength & Endurance Study

6-Month w/wo Protein Supplement

Group Results	Protein Supplement	No Supplement
Percent Fat (%)	-4.0	-2.8
Lean Weight (lbs)	+5.5	+3.9
Fat Weight (lbs)	-9.0*	-4.9

*** Significantly different from no supplement group**

Youth Strength Training Perceptions vs. Reality



Youth Strength Training



**Can children do
strength exercise?
Should children do
strength exercise?**



Youth Strength Training



**Can't Build Muscle?
No Testosterone?**

**Women and children
can build muscle.**

2.5 lbs. in 2 months.

(Westcott et al. 1995)



Youth Obesity



Study 1

8-week study, fifth grade students experienced significant improvements in body composition from 2 weekly 50-minute activity sessions that included 7 strength exercises.

- 2.7-% reduction in percent fat
- 3.0-lb. decrease in fat weight
- 2.5-lb. increase in lean weight

Westcott, Tolken and Wessner, 1995

Journal of Strength and Conditioning, 17: 5-9



Youth Strength Training



**Can't Gain Strength?
No Testosterone?**

**Women and children can
gain strength.**

74% increase in 2 months.

(Faigenbaum et al. 1993)



Strength Training in Children

Faigenbaum et al. 1993

(PES)

Training Program

Subjects:	23 Children (Mean Age = 10.4 years) 14 Exercisers, 9 Controls
Training Period:	8 Weeks
Training Frequency:	2 Days Per Week
Training Exercises:	Leg Extension, Chest Press, Leg Curl, Overhead Press, Biceps Curl
Testing Exercises:	Leg Extension, Chest Press

Strength Training in Children

Faigenbaum et al. 1993

(PES)

Training Program

Exercise Group: _____ 3 Sets X 10-15 Reps
First Set = 50% 10 RM
Second Set = 75% 10 RM
Third Set = 100% 10 RM

Control Group: _____ No training throughout study

Strength Training in Children

Faigenbaum et al. 1993

(PES)

Results

	Percent Change Training Period	Comparison To 6 RM Group
Leg Extension	+64.5%	+53.5%
Chest Press	+64.1%	+41.1%

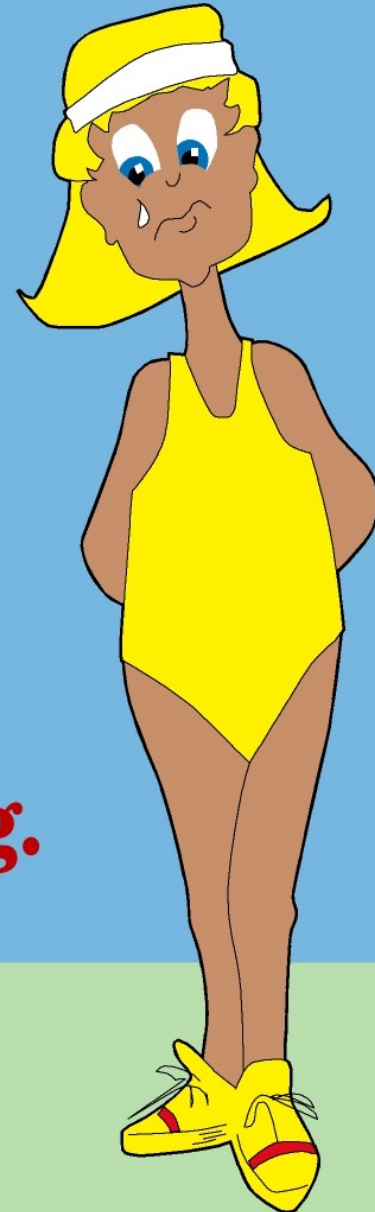
Youth Strength Training



**Strength Gains
Temporary -
No Advantage?**

**Sig. stronger after 2
months without training.**

(Faigenbaum et al. 1996)



Strength Training and Detraining in Children

Faigenbaum et al. 1996

(JSCR)

Training Program

Subjects:	20 Children (Mean Age = 10.2 years) 11 Exercisers, 9 Controls
Training Period:	8 Weeks
Detraining Period:	8 Weeks
Training Frequency:	2 Days Per Week
Training Exercises:	Leg Extension, Chest Press, Leg Curl, Overhead Press, Biceps Curl
Testing Exercises:	Leg Extension, Chest Press

Strength Training and Detraining in Children

Faigenbaum et al. 1996

(JSCR)

Training Program

Exercise Group:	First Month:	2 Sets x 6 RM.
	Second Month:	3 Sets x 6 RM.
	Third Month:	No Training
	Fourth Month:	No Training

Control Group: No training throughout study

Strength Training and Detraining in Children

Faigenbaum et al. 1996

(JSCR)

Results

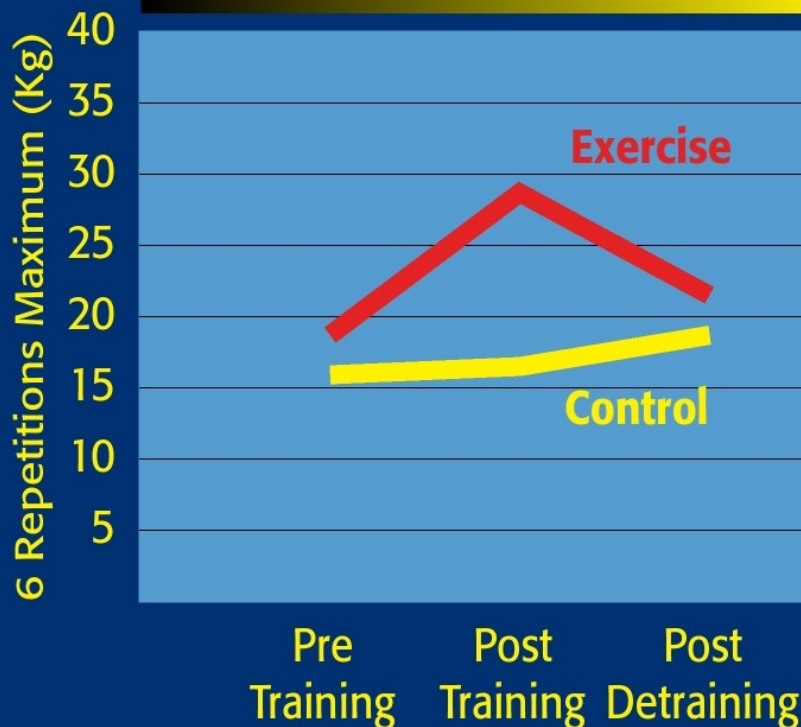
	Percent Change Training Period	Percent Change Detraining Period
Leg Extension (6 RM)	+53.5%	-28.1%
Chest Press (6 RM)	+41.1%	-19.3%

Strength Training and Detraining in Children

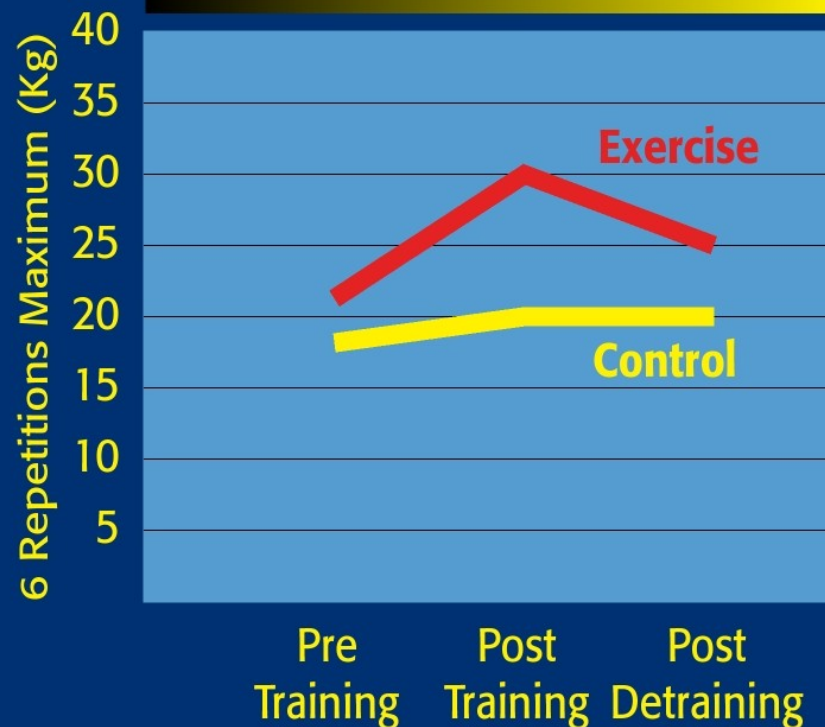
Faigenbaum et al. 1996

(JSCR)

Leg Extension



Chest Press



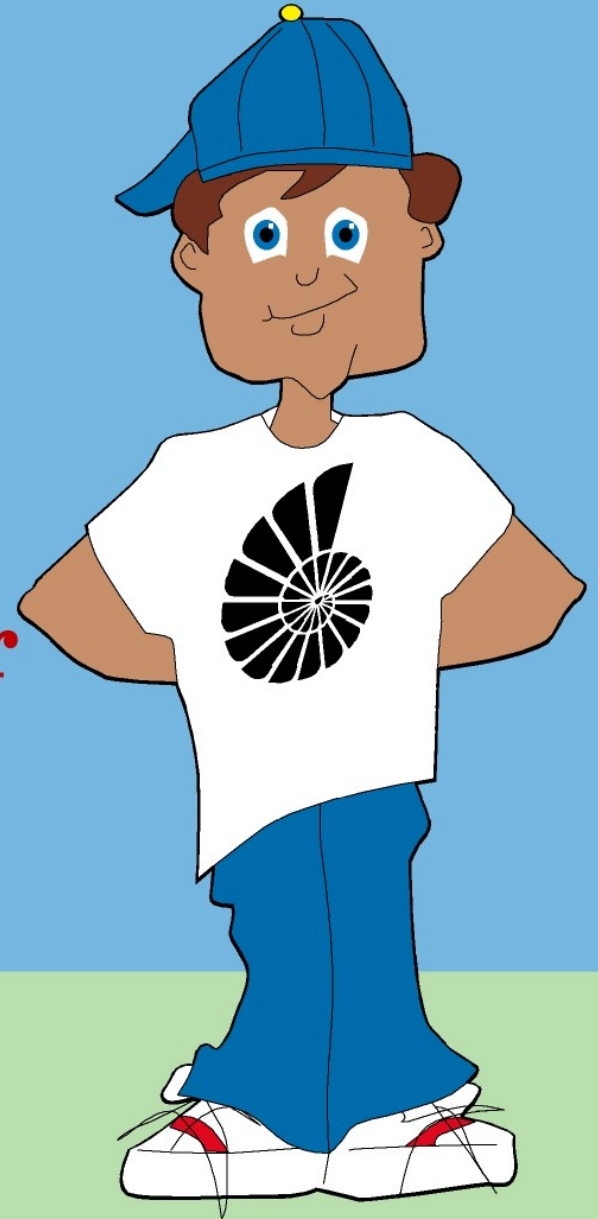
Youth Strength Training



**Single-Set Training
Sufficient.**

**DeLorme system better
than Berger System**

(Faigenbaum et al. 1993, 1996)



Youth Strength Training



**Higher Repetitions
Preferred.**

**14 Reps vs. 7 Reps
Greater Gains and
Lower Risk**

(Faigenbaum et al. 1999)



Faigenbaum et al

Youth Strength Training

*Low Repetition - Heavy Load vs.
High Repetition - Moderate Load*

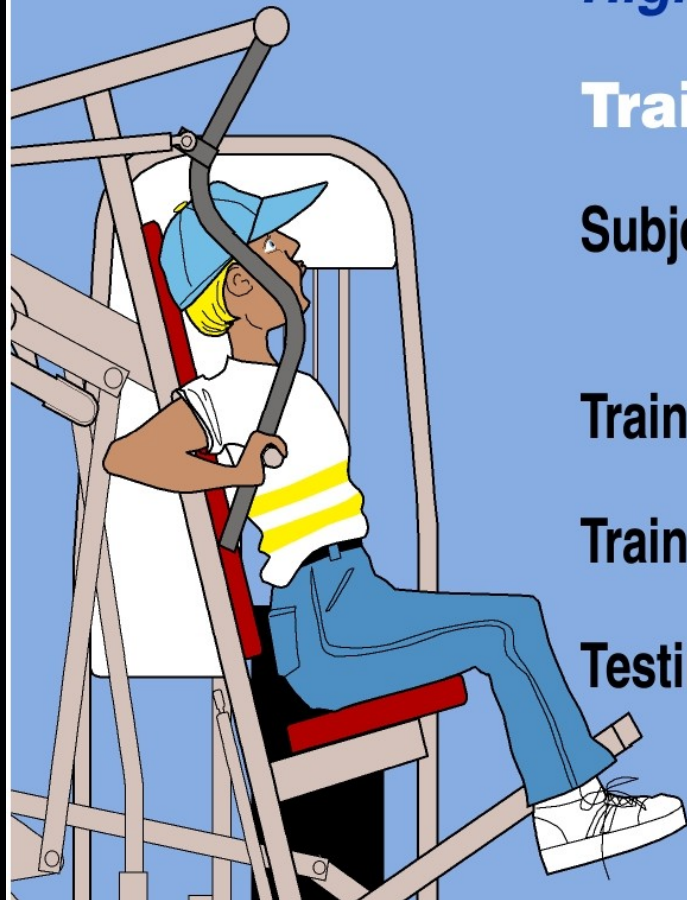
Training Program

Subjects: 43 Children (Mean Age = 8.3 years)
31 Exercises, 12 Controls

Training Period: 8 Weeks

Training Exercises: 11 Child-Sized Machines

Testing Exercises: Leg Extension, Chest Press



Faigenbaum et al

Youth Strength Training

*Low Repetition - Heavy Load vs.
High Repetition - Moderate Load*

Training Program

Exercise Group 1: 1 Set x 6-8 Reps (n=15)

Exercise Group 2: 1 Set x 13-15 Reps (n=16)

Control Group: No Training (n=12)



Faigenbaum et al

Youth Strength Training

*Low Repetition - Heavy Load vs.
High Repetition - Moderate Load*

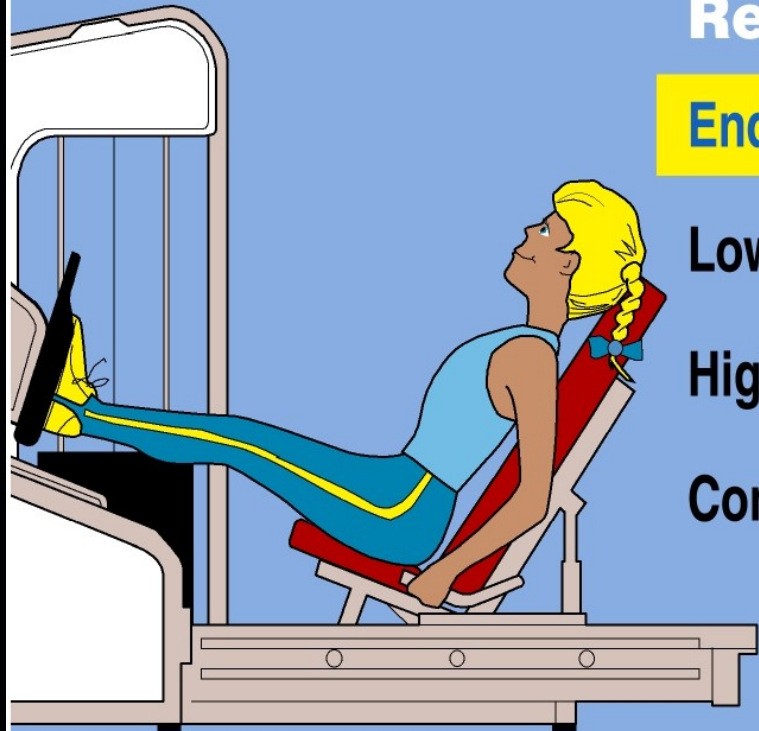
Results

Endurance Gains	Leg Extension	Chest Press
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Low Rep Group	+8.7 Reps	+3.1 Reps
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High Rep group	+13.1 Reps	+5.2 Reps
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Control Group	+3.7 Reps	+1.7 Reps
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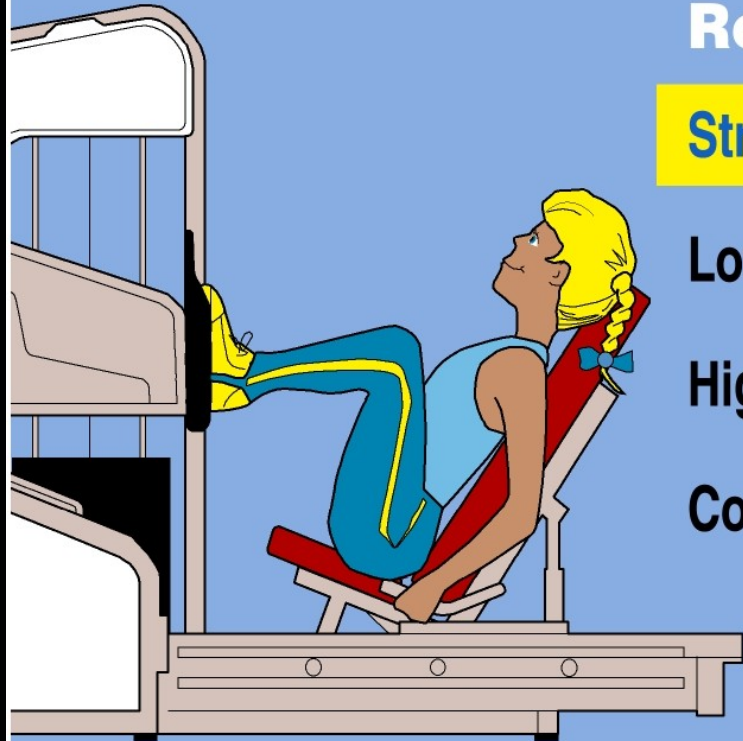
Faigenbaum et al

Youth Strength Training

*Low Repetition - Heavy Load vs.
High Repetition - Moderate Load*

Results

Strength Gains	Leg Extension	Chest Press
Low Rep Group	+31.0%	+5.3%
High Rep group	+40.9%	+16.3%
Control Group	+13.6%	+4.2%



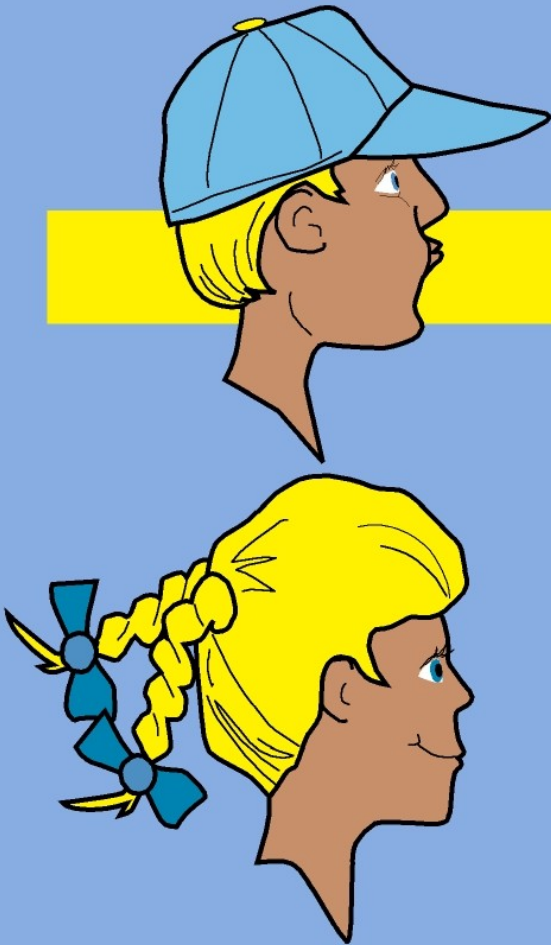
Faigenbaum et al

Youth Strength Training

*Low Repetition - Heavy Load vs.
High Repetition - Moderate Load*

Conclusion

This study demonstrates that one set of high repetition - moderate load training may be more beneficial than one set of low repetition - heavy load training for children participating in an introductory program of strength training.



Youth Strength Training



**Bodyweight Exercise?
Safer?**

**Typically Too Heavy or
Too Light.**





Youth Strength Training



Training Guidelines

- **Select Basic Exercises for Major Muscles**
- **4 Multiple-Muscle Exercises**
- **12 Single Muscle Exercises**



Youth Strength Training



$$1 \times 12 = 12$$

$$2 \times 6 = 12$$

$$3 \times 4 = 12$$

Training Guidelines

■ 12 Exercise

■ 6 Exercises

■ 4 Exercises

1 Set Each

2 Sets Each

3 Sets Each



Youth Strength Training



Training Guidelines

- **Perform 10 to 15 Repetitions Per Exercise**
- **Use Slow Movement Speed**
- **Use Full Movement Range**

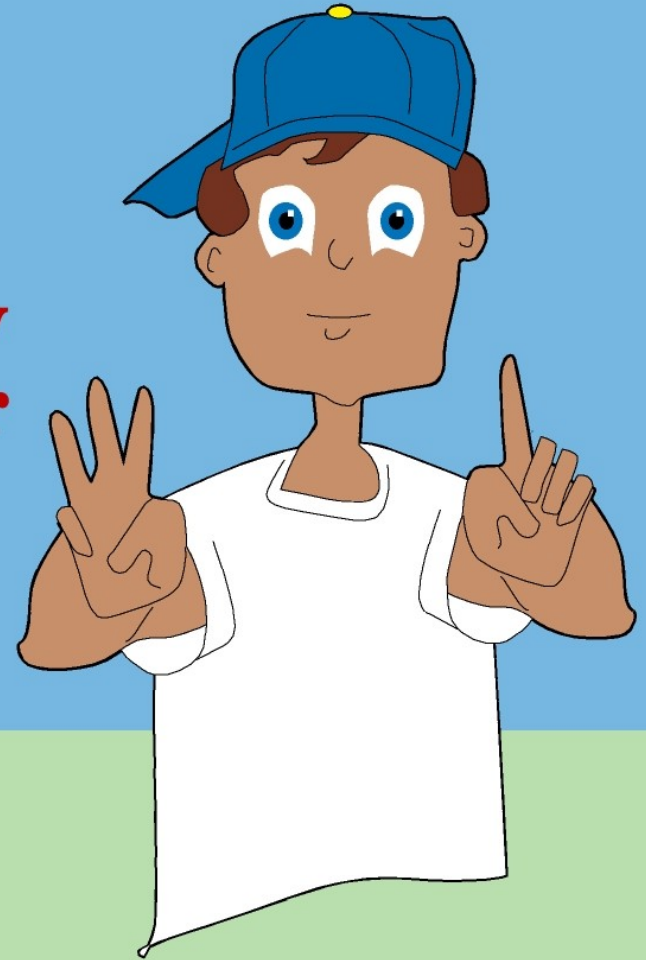


Youth Strength Training



Training Guidelines

- **Increase Resistance by 1 to 3 Pounds Whenever 15 Repetitions are Completed With Good Form**
- **Be Progressive**
- **Be Safe**

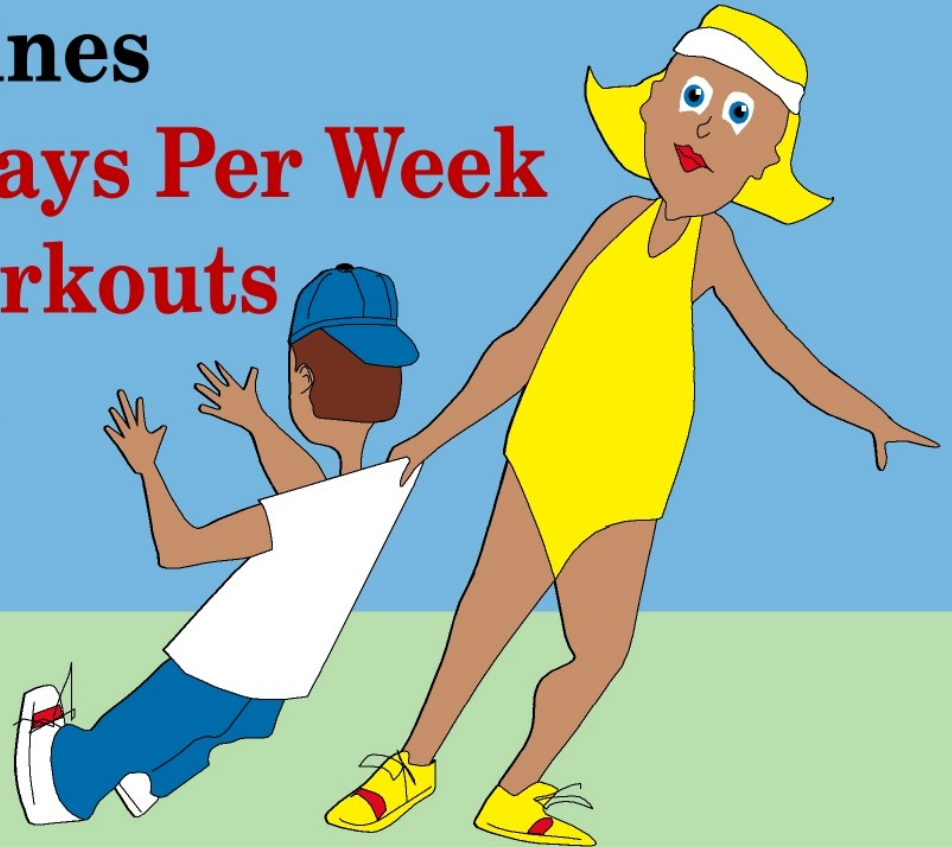


Youth Strength Training



Training Guidelines

- **Train 2 or 3 Days Per Week**
- **Record All Workouts**
- **Be Consistent**

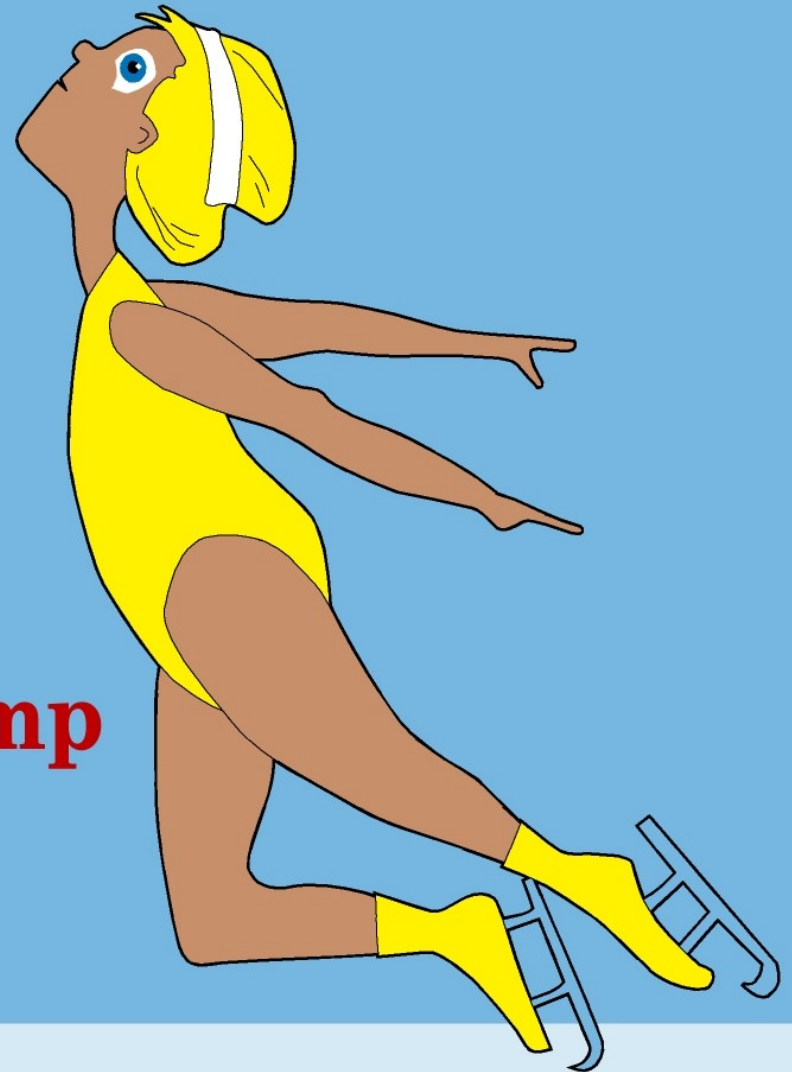


Youth Strength Training



**Enhanced Sports
Performance**

**Figure Skaters Jump
Higher**



(Westcott et al. 1999)

Effects of Strength Training On Young, Female Figure Skaters

Subjects: 16 girls
8-13 yrs ($x = 10$)

Frequency: 1 or 2 days/week - 10 weeks

Protocol: 1 set of 13-15 reps

Equipment: Under 10 - Child Sized
Over 10 - Nautilus



(Westcott et al, 1999)

Effects of Strength Training On Young, Female Figure Skaters

Results - 10 Weeks

Lower Body Strength 47.4 - 94.5 lbs. (99%)

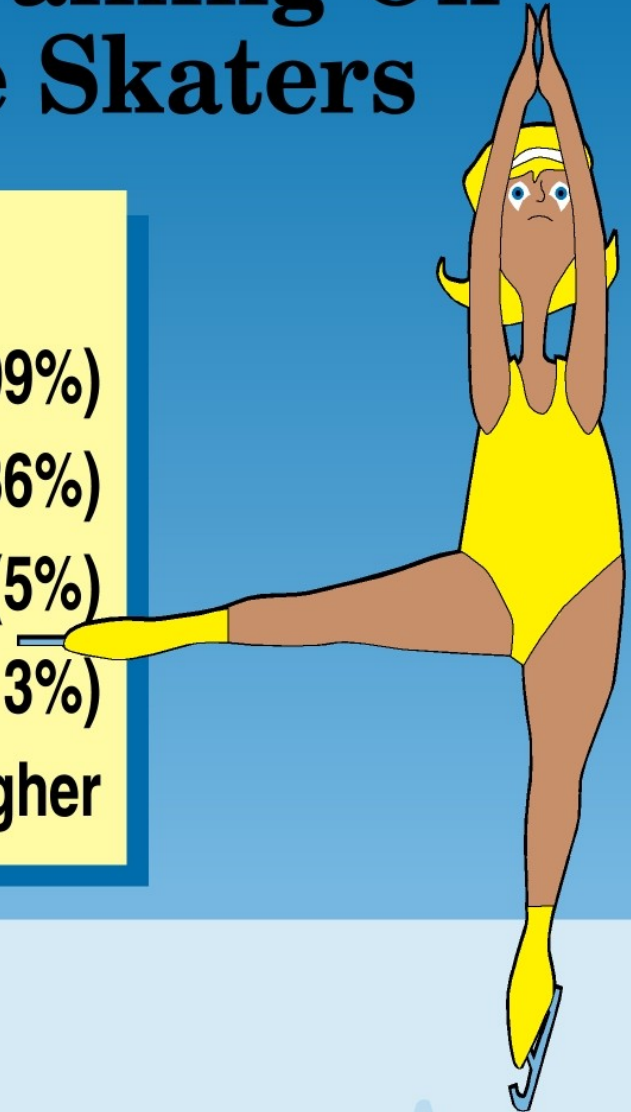
Upper Body Strength.....31.7 - 43.2 lbs. (36%)

Hamstring Flexibility 19.8 - 20.9 (5%)

Vertical Jump 10.2 - 11.5 in. (13%)

On Ice Jumps Much Higher

(Westcott et al, 1999)



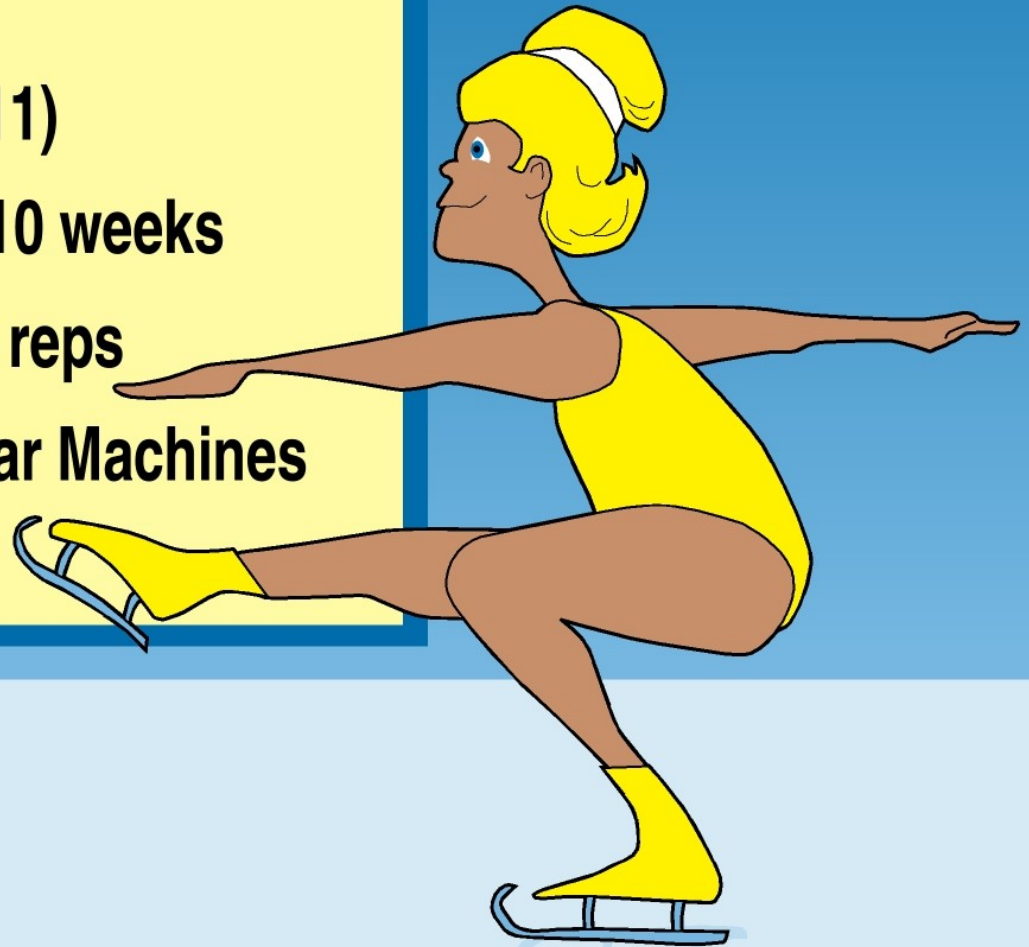
Effects of Strength Training On Young, Female Figure Skaters

Subjects: 10 girls
8-13 yrs ($x = 11$)

Frequency: 1 day/week - 10 weeks

Protocol: 1 set of 13-15 reps

Equipment: Nautilus Linear Machines



(Westcott et al, 1999)

Effects of Strength Training On Young, Female Figure Skaters

Results - 10 Weeks

Muscle Gain 80.2 - 82.7 lbs. (2.5 lbs.)

Upper Body Strength.....34.4 - 49.8 lbs. (45%)

Hamstring Flexibility 16.9 - 18.1 in. (7%)

Long Jump 4.5 - 4.9 ft. (9%)

(Westcott et al, 1999)



Sports Injuries

High School Athletics Highest Injury Rate

Girls Cross - Country

Dr. Stephen Rice –
60,000 athletes in 18 interscholastic sports



Notre Dame High School Cross-Country and Track Team

**Strength Training: Winter and Summer
30 Runners**

12 Nautilus Exercises

- Three Days Per Week
- 1 Set of 8 – 12 Repetitions

Results: 4 Years

- 4 Mass. And New England Championships
- Only 1 Injury





2005 ACSM Exercise Guidelines

Muscular Strength:

- **1 Set/Exercise**
- **8-12 Reps/Set (Range 3-20)**
- **8-10 Exercises for Major Muscles**
- **2-3 Nonconsecutive Days/Week**
- **Moderate Movement Speed (6 Secs/Rep)**
- **Full Movement Range (Pain Free)**











Circuit Strength Training Town Sports International (Spring 2003)



Westcott, Hatton, La Rosa Loud,
D'Arpino

Circuit Strength Training

Town Sports
International

Personal trainers:
Complex system of strength
training

Prospective Members:
Simple system of strength
training

Research Study:

Assess response to two strength training program
options

Circuit Strength Training

TSI Xpressline Strength Training Program

- 8 weeks
- 8 exercises
- 1 set each
- 8 - 12 repetitions
- 3 x week
- instructor present

Exercise Machines (Nautilus Nitro)

Leg Press

Shoulder Press

Leg Extension
Press

Chest

Leg Curl

Biceps Curl

Lat Pull Down

Triceps

Training Time: 15 minutes

Circuit Strength Training

TSI Individualized Strength Training Program

- 8 weeks
- 8 – 16 exercises
- 2 – 3 sets each
- 8 – 12 repetitions
- 3 x week
- initial instruction
- combination free-weights and machines

Training Time: 45 – 90 minutes

Circuit Strength Training

Research Study Results

- 41 beginning participants (new members)
 - 27 chose Xpressline Program (66%)
 - 14 chose Individualized Program (34%)
- 29 ending participants
 - 21 of 27 Xpressline Exercisers (78%)
 - 8 of 14 Individualized Exercisers (57%)

Circuit Strength Training

Research Study Results

Individualized Xpressline

Body Weight _____ +0.4 lbs. _____ - 1.9 lbs.

Percent Fat _____ -2.5 % _____ - 2.2%

Fat Weight _____ - 4.3 lbs. _____ -3.9 lbs.

Lean Weight _____ + 4.6 lbs. _____ + 2.0

Circuit Strength Training

Research Study Conclusions

Key Points

- 2 of 3 new members preferred to participate in the Xpressline program.
- 3 of 4 Xpressline participants completed the program compared to 2 of 4 Individualized participants.
- Xpressline participants gained twice as much lean weight as Individualized participants.
- Circuit Strength Training is a highly effective program for new exercisers.

Circuit Strength Training U.S. Air Force Research Study



**Westcott, Annesi, Skaggs, Gibson, Reynolds,
O'Dell**

Circuit Strength Training

U.S. Air Force Research Study

U.S. Air Force Required Annual Fitness Assessment

- | | |
|----------------------------------|-------|
| 1. 1.5 Mile Run Time | (50%) |
| 2. Abdominal Circumference | (30%) |
| 3. 1 - Minute Push ups | (10%) |
| 4. 1 - Minute Abdominal Crunches | (10%) |

*80% of overall test results based on endurance run and abdominal circumference

*Overweight individuals have lower probability of passing



Circuit Strength Training U.S. Air Force Research Study

Traditional Training For Personnel Who Fail Test

Recommendations:

1. Perform approximately 60 minutes of mostly aerobic exercise (with heart rate monitoring)
2. Train 4 to 5 days per week
3. Retest within 90 days



Circuit Strength Training U.S. Air Force Research Study

Circuit Strength Training For Personnel Who Fail Test

Recommendations:

1. Perform approximately 25 minutes of circuit strength training
2. Train 3 days per week
3. Retest within 90 days



Circuit Strength Training

U.S. Air Force Research Study

Circuit Strength Training For Personnel Who Fail Test

Procedures:

1. Perform 60 seconds (1 set of 15 to 20 repetitions, using 40 to 60% of maximum resistance) of the following weightstack machine exercises.

*Squat

*Shoulder Press

*Leg Curl

*Lat Pull Down

*Leg Extension

*Triceps Press

*Chest Press

*Biceps Curl

*Seated Row

*Abdominal

Crunch



Circuit Strength Training U.S. Air Force Research Study

Circuit Strength Training For Personnel Who Fail Test

Procedures:

2. Perform 60 seconds of stationary cycling between successive strength exercises.
3. Transition quickly (about 5 seconds) from station to station



Circuit Strength Training U.S. Air Force Research Study

Pre-Training To Post-Training Test Results Aerobic Exercise Group

26 Participants

Assessment Area Difference*	Pre	Post	
1.5 Mile Run (seconds)	1033.7	1018.3	-15.4
Abdominal Circumference (cm)	98.6	98.3	-0.3
Push-Ups	32.3	31.9	-0.4
Abdominal Crunches		34.5	34.7 +0.2
Total Test Score	52.3	54.1	+1.8

*No statistically significant change in any assessment

Circuit Strength Training U.S. Air Force Research Study

Pre-Training To Post-Training Test Results Circuit Training Group

57 Participants

Assessment Area Difference*	Pre	Post	
1.5 Mile Run (seconds)	1055.7	1020.4	-35.3*
Abdominal Circumference (cm)	98.4	94.9	-3.5*
Push-Ups	29.3	36.4	+7.1*
Abdominal Crunches +5.8*		30.2	36.0
Total Test Score	50.5	60.5	+10.0*

Circuit Strength Training U.S. Air Force Research Study

Summary and Conclusions

- *Aerobic Exercise Program was not effective for improving test scores in any assessment area.
- *Circuit Strength Training Program was effective for improving test scores in all assessment areas.
 - Non-weight-bearing exercises (weight stack machines and stationary cycles)
 - Shorter exercise sessions (25 minutes) and briefer exercise segments (60 seconds)
 - Less frequent exercise sessions (3 days/week)

Circuit Strength Training U.S. Air Force Research Study

Summary and Conclusions

Circuit Strength Training preferable to Standard Aerobic Exercise for improving physical fitness in poorly conditional and overweight Air Force personnel.



Stress Axis - Exercise



**Dopamine
Serotonin**



Sleep

**Posterior Hypothalamus
Anterior Pituitary
Adrenals**

Nutrition



Exercise



Stress Axis - Exercise

- **Too Much Stress - Imbalance** ▼ Immune System
 - **Too Little Stress - Imbalance** ▼ Immune System
 - **Appropriate Stress - Balance** ▲ Immune System
- **Nutrition: USDA Pyramid**
 - **Sleep: 8-9 Hours/Day**
 - **Exercise: 20 Mins Strength: 2/wk**
20 Mins Endurance: 3/wk



Presentation Objectives

1. Participants will learn that sedentary aging is associated with **muscle loss, metabolic slow-down, and fat gain.**
2. Participants will learn that **strength training** is the only intervention that successfully addresses all 3 physiological problems.

Presentation Objectives

continued

3. Participants will learn that 10 weeks of basic strength exercise is likely to increase **muscle mass** by about 3 pounds, increase **resting metabolism** by about 7 percent, and decrease **fat mass** between 4 to 10 pounds (depending upon dietary changes).

Presentation Objectives

continued

4. Participants will learn that basic strength exercise may **reduce the risk** of diabetes, colon cancer, heart attack, stroke, back pain, arthritic pain, depression, and osteoporosis.
5. Participants will learn that effective strength training requires only **8 to 10 exercises**, performed for **1 set of 8 to 12 repetitions**, **2 nonconsecutive days a week**.